Risk-Based Cleanup Request

Revision 1

School Site at McCoy Field
New Bedford, Massachusetts
RTN 4-15685

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Prepared for:

New Bedford School Department
New Bedford, Massachusetts

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1.0 EXECUTIVE SUMMARY

1.1 Purpose of Submission

This document constitutes a Risk-Based Cleanup Request under 40 CFR 761.61(c) for polychlorinated biphenyl (PCB) remediation waste within the portion of the McCoy Field Site (the "Site") hereinafter referred to as the School Site. The School Site is bounded by a security fence, as shown in Figure 2, and encompasses landscaped areas, paved areas, and areas within the building footprint. The "Site Wetlands", also illustrated on Figure 2, will be addressed in a separate risk-based cleanup request.

The School Site is the construction site for the New Keith Middle School, and therefore will be considered a high occupancy area. If a self-implementing cleanup were to be conducted under §761.61(a)(4)(i)(A), a cleanup level for bulk PCB remediation waste of ≤1 ppm would be required without further conditions; waste at concentrations >1 ppm and ≤10 ppm would be allowed to remain in areas covered with a cap meeting the requirements of paragraphs (a)(7) and (a)(8). Since engineered controls and an Activity and Use Limitation (AUL), will be implemented to limit exposure, this Risk-Based Cleanup Request is being submitted with the goal of allowing PCB remediation waste to remain at the School Site. Consistent with Massachusetts Contingency Plan requirements, all soil containing PCB concentrations =100 ppm encountered during excavation activities has been delineated, excavated, and managed off-Site.

1.2 Site Background

The property formerly known as McCoy Field (the Site), previously a recreational field occupied by three soccer fields, is the construction site for the New Keith Middle School. The Site is bounded by Hathaway Boulevard to the east, Durfee Street to the north, Summit Street to the west, and Ruggles Street to the south (Figure 2). Much of the material underlying the former soccer fields is relocated fill material from the current high school location (east of the Site, across Hathaway Boulevard), where historic dumping and burning activities were reportedly performed prior to construction of the high school in the early 1970s. In or around 1994, the PCB-contaminated debris was spread across the Site and graded for the purposes of athletic field construction. The waste was covered with a sand/gravel leveling course and topsoil prior to construction of the soccer fields. The maximum depth of waste at the Site is 14 feet. As a result, the following distinct horizons are present at the Site:

- Topsoil;
- Sand/gravel layer;
- Fill material;
- Native organic silt; and,
- Native glacial till.

Embankments mark the edge of the fill placement along the northern and western boundaries of the filled area. These embankments lead down to deciduous wood swamp wetland areas where fill material was not historically placed. However, constituents from the fill material have migrated to the wetland area from environmental processes such as wind erosion and surface water runoff. A separate risk-based cleanup request will be submitted for the "Site Wetlands".

1.3 Cleanup Plan

In order to limit potential exposure associated with future School Site activities, the accessibility of all PCB remediation waste at the School Site will be limited by means of being located:

1) Under the building footprint, two feet beneath the gas vapor barrier and venting system;
2) Beneath three feet of clean fill in landscaped (unpaved) areas; or
3) Beneath a minimum of two feet of clean granular fill in paved areas.

Clean corridors have been or will be established for all Site utilities to facilitate worker safety during installation and future maintenance.

An Activity and Use Limitation (AUL) will be placed on the School Site because the Method 3 Risk Characterization performed pursuant to the Massachusetts Contingency Plan (310 CMR 40.0990) relies on limited exposure potential to achieve a level of No Significant Risk. The AUL will require maintenance of three feet of clean soil in landscaped areas and two feet of granular materials in paved areas. Excavation will be limited to within clean corridors, unless otherwise approved by a Massachusetts Licensed Site Professional (LSP), and shall be performed by only authorized personnel. A Draft AUL is included as Attachment A.

At the request of EPA, a warning barrier has been placed at all landscaped areas of the School Site, not including paved areas or the building footprint.

1.4 Human Health Risk Characterization

Human receptors anticipated to be present at the future Keith Middle School include the following:

- Students
- School employees
- Visitors
- Municipal employees (such as persons from public works, the water department, etc.)

The exposure management barriers and activity and use limitation (AUL) to be established at the school will prevent students, school employees, and visitors from contacting underlying fill material and will also prohibit soil disturbance activities by municipal workers or similar groups without the explicit involvement of a Massachusetts Licensed Site Professional (LSP). Therefore, the exposure pathway to students, school employees, visitors, or municipal workers to fill underlying exposure management barriers is incomplete.

Intrusion into fill material underneath the exposure management barriers could only result from unintended and/or unauthorized breaching of the exposure management barriers. To contact in-place fill material, a person would need to:

- Penetrate the building foundation;
- Dig through three feet of clean material in landscaped areas; or
- Dig through paving and a minimum of two feet of granular materials (including the warning barrier).

It is considered highly unlikely that such activities would be performed by Site personnel. Awareness training of maintenance staff will be provided by BETA.

2.0 SITE BACKGROUND

2.1 Site History and Setting

BETA Group, Inc. (BETA) has been retained by the City of New Bedford School Department to provide licensed site professional services related to the development of the New Keith Middle School at the location of the current McCoy Field (the "Site"). McCoy Field consists of approximately seven acres of land on the west side of Hathaway Boulevard, opposite New Bedford High School. Polychlorinated biphenyl (PCB)-contaminated burn debris from a former City burn dump was placed at the Site in the late 1960s/early 1970s. In or around 1994, PCB-contaminated debris was spread across the Site and graded for the purposes of athletic field construction.

Pre-construction investigations of McCoy Field revealed the presence of Reportable Concentrations (RCs) of several contaminants in soil, including lead, barium, PCBs and other semivolatile organic compounds (SVOCs). Initial subsurface investigations conducted in April 2000 by Miller Engineering & Testing, Inc. (Miller) identified four distinct horizons in soil in the playing field: surface soil, a gravel layer, fill (ash & C&D wastes), and native soil. For the purpose of characterizing the soil for disposal, BETA grouped the gravel layer with the fill layer, and separated the native soil into the organic silt layer and the glacial till layer. Previous sampling efforts established that the surface soil is suitable for on-site reuse; therefore, no samples were collected from the surface soil layer.

PCB analytical results from samples collected in March 2004 identified PCB concentrations at ≥50 ppm at the Site. Based on these results and past Site activities, PCB-contaminated materials meet the definition of a *PCB remediation waste*, as defined under federal PCB regulations at 40 CFR 761.3. *PCB remediation waste* is regulated under the Toxic Substances Control Act (TSCA) and the PCB regulations at 40 CFR Part 761. The PCB regulations require disposal of *PCB remediation waste* at ≥50 ppm in a TSCA-permitted disposal facility or a RCRA hazardous waste landfill; *PCB remediation waste* at <50 ppm may be disposed of in a state-approved non-hazardous waste landfill.

In accordance with a Consent Agreement and Final Order (CAFO) between EPA and the City of New Bedford (the City), the City has conducted sampling and removed the PCB-impacted soil located in the proposed utility corridors and in the vicinity of the proposed building pile caps and grade beams at the Site. The CAFO also required development of a Work Plan that details the work. Revision 2 of the EPA Work Plan was appended to the CAFO executed by the EPA on May 21, 2004.

Since the original CAFO addressed only soil located in the utility corridors and in the vicinity of the proposed building pile caps and grade beams at the Site, the CAFO was amended on October 25, 2004 to encompass sampling and removal to be addressed under Revision 3 of the EPA Work Plan. The scope of work at the Site was expanded by Revision 3 of the EPA Work Plan, submitted on November 5, 2004, to include sampling and removal of PCB-impacted soil for installation of the elevator shaft, acid neutralization tanks, AST foundation, light stanchions, detention basins, drain lines, water line, landscaped areas, wetlands, and the neighboring properties in the vicinity of Durfee Street and Nemasket Street.

As part of the school construction project, an initial site preparation contract (Phase I) was prepared and awarded for construction of clean corridors, installation of subsurface utilities, and stabilization of the embankment along the northern and western perimeter of the existing soccer fields. Phase I Work was observed by BETA staff from approximately May 6, 2004 through November 16, 2004. Work to be completed under the Phase II contract includes excavation and management of soil in the location of proposed utility corridors, building pile caps and grade beams, AST foundation, light stanchions, detention basins, drain lines, water line, and landscaped areas. All necessary off-site management options are provided for under Phase I and Phase II construction contracts. In accordance with the provisions of the EPA Work Plan, BETA conducted extensive in-situ sampling from February 2004 through February 2005 to characterize soil and assess off-site management options. Phase I activities are complete and Phase II activities are in the final stages of completion.

BETA Group, Inc. has consulted with EPA and DEP concerning the submittal of this Risk-Based Cleanup Request for the School Site separate from a request for the cleanup of the Site Wetlands. The intent in submitting a separate request for the School Site is to help expedite approval for this portion of the Site, so as not to delay construction of the New Keith Middle School.

2.2 Nature of Contamination

Activities conducted to date under the EPA Work Plan (last revised November 5, 2004) include sampling and removal of PCB-impacted soil for installation of clean utility corridors, building pile caps and grade beams, elevator shafts, acid neutralization tanks, AST foundation, light stanchions, detention basins, drain lines, water line, landscaped areas, and for stabilization of the embankments abutting the Site Wetlands. Sample locations are shown on Figures 1.1 through 1.6. Tabulated PCB analytical results are included as Attachment C. For each area of the School Site (i.e. Landscaped Area, Pile Caps, Grade Beams, etc.) the samples are divided into the following categories:

- Characterization samples – these samples were collected to characterize soil to be excavated for off-site disposal. Characterization samples are representative of soil that was disposed off-site.
- Delineation samples – these samples were collected either to narrow down the limits of PCB remediation waste > 50 ppm in order to limit disposal cost or to determine the extent of soil requiring removal due to exceedance of an Upper Concentration Limit. Delineation samples are representative of soil that was disposed off-site.
- Confirmation/Remaining samples – these samples are representative of soil remaining at the Site beneath the engineered barriers discussed in Section 3.3. Confirmation/Remaining samples fall into the following categories:
    1. Samples collected as delineation samples which marked the edge of a delineation;
    2. Samples collected as characterization samples for material that did not end up requiring excavation;
    3. Samples collected as characterization samples for material that was excavated and then used as backfill either in the building footprint or in light stanchion excavations.

Laboratory analytical results are provided on CD-ROM as Attachment D.

2.2.1 Soil/Fill

Pre-construction investigations at the Site identified the presence of constituents in fill material at concentrations above Massachusetts Department of Environmental Protection (MADEP) Reportable Concentrations (RCs).

Based on investigations conducted in the fill area of the Site between 2000 and the present, constituents present in soil/fill material that will remain on-Site underneath exposure management barriers include PCBs, lead, barium, and several semi-volatile organic compounds. A complete list of all contaminants of concern is included in Table 1.

Volatile organic compounds (VOCs) were detected in soil/fill material infrequently and at low concentrations. Of the twelve VOCs detected, eleven are petroleum-related compounds. Maximum detected concentrations of all individual VOCs, as well as the combined concentration of C9-C10 aromatic compounds, are below their applicable MCP Method 1 S-3 soil standards (i.e., S-3/GW-2 and/or S-3/GW-3).

Numerous semi-volatile organic compounds (SVOCs) were detected; the majority (18) are either polycyclic aromatic hydrocarbons (PAHs) or phthalic acid esters.[1] Six PAHs were detected at maximum and/or arithmetic mean concentrations above their applicable Method 1 S-3 soil standards. Several additional SVOCs were detected in soil/fill, but were detected infrequently (in 1% or less of samples) and at concentrations below their applicable Method 1 S-3 soil standard or U.S. EPA Region 9 preliminary remedial goal (PRG) for industrial soil. Benzidine was detected once, at a concentration above its U.S. EPA Region 9 PRG for industrial soil.

Polychlorinated biphenyls (PCBs) were detected in about 77% of the soil samples analyzed. PCBs were typically reported as Aroclor-1254; in about one percent of the samples, PCBs were reported as Aroclor-1248 and in less than 1% of samples as Aroclor-1260, -1262, or -1268. Total PCB concentrations ranged from less than detectable to a maximum of 46,500 mg/kg. The arithmetic mean of the detections (i.e., not including the non-detected results) was 77.12 mg/kg; however, this concentration is skewed by the anomalously high maximum value. The median concentration is 8.09 mg/kg and the geometric mean concentration is 9.03 mg/kg. Figure 7 presents a distribution histogram of log-normalized PCB detections; the apparent normal distribution of the log-normalized data suggest that the data follow a log-normal distribution and that the geometric mean may be more representative of the central tendency of the data. The 90th percentile concentration of the PCB detection data set is 51.2 mg/kg.

Eight RCRA metals were detected in Site soil/fill material: arsenic (95% of samples); barium (100%); cadmium (89%), total chromium (100%), lead

(~100%), mercury (89%), selenium (3%), and silver (37%). Maximum detected concentrations of cadmium, total chromium, mercury, selenium, and silver were below their respective Method 1 S-3 soil standards. While maximum detected concentrations of arsenic and barium exceeded their respective Method 1 S-3 soil standards, their arithmetic mean concentrations were below their respective Method 1 S-3 soil standards. Both the maximum detected and arithmetic mean concentrations of lead exceeded its Method 1 S-3 soil standard.

The attached Table 3 summarizes analytical data for chlorinated dibenzo-p-dioxins and dibenzofurans (CDDs/CDFs) for soil/fill samples collected from the McCoy Field Site. Eight samples, including two duplicates, were collected. A variety of CDDs/CDFs were detected; the highest concentrations were hepta- and octa-substituted dioxins and furans.

Each reported sample concentration of an individual CDD/CDF was converted to a 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalent (2378-TCDD TEq) using the WHO-98 scheme, as recommended in the draft dioxin reassessment documents (U.S. EPA 2000).[2] 2378-TCDD TEqs for each CDD/CDF in a sample were then summed to derive a total 2378-TCDD TEq for the sample. In the eight samples, total 2378-TCDD TEq concentrations ranged from 11.7 pg/g (parts per trillion) to 54.8 pg/g. All total 2378-TCDD TEqs, while above Method 1 soil standards, were below the MCP upper concentration limit of 200 pg/g.

2.2.2 Groundwater

Sampling of temporary observation wells at four locations on the School Site identified only non-detect and trace levels of heavy metals, VOCs, SVOCs, PAHs and EPH compounds. A summary of analytical results is presented in Table 3. Reference is made to Figures 1.1 and 1.2 for locations of the temporary monitoring wells.

No further groundwater sampling has been performed; however, three monitoring wells are proposed in the Draft Environmental Monitoring Plan (Attachment F).

2.2.3 Soil Gas

This section summarizes the evaluation of soil gas results from McCoy Field in New Bedford. The soil gas results, summarized in Table 5, were evaluated for the potential to adversely impact indoor air or an overlying building with no vapor barrier due to vapor diffusion into the building. The conclusion of the evaluation is that no significant risk to human health is posed by measured soil gas concentrations.

The evaluation was conducted using a component of the Johnson & Ettinger (1991) model; specifically, through calculating a steady state indoor air attenuation coefficient (α), that describes the reduction in concentration when soil gas intrudes and distributes inside of a building. Average detected soil gas concentrations of each constituent (with a few exceptions, noted below) were combined with this attenuation coefficient and with an intake factor describing the intermittent exposure of an on-Site worker (assessed for 8 hours per day, 250 days per year, 25 years)[3] to derive an indoor air exposure point concentration. The exposure point concentration was then combined with the constituent's appropriate inhalation toxicity value (either a reference concentration for non-carcinogenic constituents or an inhalation unit risk value for carcinogenic constituents) to quantify potential health risks. Constituent-specific non-carcinogenic hazard indices and cancer risks were each summed among all constituents to derive an overall Hazard Index of 0.02 and excess lifetime cancer risk of 6×10^{-7}. These values are below the maximum acceptable Hazard Index of 1.0 and excess lifetime cancer risk of 1×10^{-5} adopted by MADEP. This indicates that inhalation exposure to constituents detected in soil gas will not pose a significant risk to human health. The many conservative approaches applied in the evaluation, as well as the fact that the building will have a vapor barrier, suggest that actual exposures, if any, will be significantly less than those estimated.

A few constituents detected in soil gas could not be assessed either because of the lack of toxicity values or chemical property data to estimate an attenuation factor. These constituents were: ethanol, propylene, 2-bromopentane, cyclopentanone, limonene, dimethyl disulfide, and trans-decahydronaphthalene. The latter five were each detected in one soil gas sample only; ethanol and propylene were detected more frequently.

Calculations of attenuation coefficients, exposure concentrations, and hazard/risk levels are presented on Tables 5 and 6. All input values are presented and referenced on these tables.

2.3 Sampling Procedures

The EPA Work Plan outlines the sampling procedures followed for this Site.

2.4 Data Validation and Usability

Samples collected for disposal characterization were routinely analyzed for PCBs, metals, and SVOCs. Originally, the soil was also characterized with respect to parameters such as VOCs, corrosivity, and ignitability; however, it was determined that only PCBs, metals, and SVOCs were significant to disposal considerations. Whenever a metal was detected in excess of 20 times its respective toxicity characteristic level, Toxicity Characteristic Leaching Procedure (TCLP) analysis was conducted. Lead was the only metal for which TCLP analysis resulted in an exceedance of the regulatory limit. In these instances, the material was stabilized for lead and a confirmatory sample was analyzed prior to excavation and disposal. A small hotspot (9 tons) of fill material contained PAHs at concentrations exceeding Upper Concentration Limits (UCLs). Although the PAH concentrations exceeded UCLs, the concentrations were within the acceptance limits of the non-hazardous waste landfill. Since PCBs presented the most significant disposal considerations, data validation was focused on PCB analytical results.

2.4.1 Technical Holding Times

All soil samples were extracted within the 14-day limit, except those samples that were held for analyses, pending receipt of the initial sample results. In some cases (less than 10%), samples analyzed for delineation purposes were extracted over 14 days after sample collection. Given that the primary objective was to characterize soil for disposal purposes at above or below 50 ppm, we do not believe that such holding time exceedances compromise the decisions made regarding off-site soil management.

2.4.2 Surrogate Recoveries

Initial problems were encountered with surrogate recoveries for PCB soil results, due to dilutions necessary to detect higher concentrations of PCBs. This issue was addressed with EPA personnel early in the waste characterization process, and the problem was rectified by assessing surrogate recoveries on straight runs, not on the 100X dilutions necessary for some soil samples.

2.4.3 Matrix Spike/Matrix Spike Duplicates

Both analytical laboratories used for this project (New England Testing Laboratories, Inc. and Alpha Analytical, Inc.) were provided with matrix spikes and matrix spike duplicates in accordance with the Work Plan. Over the course of the project, we observed significant variations in the analytical results, including respect to relative percent differences up to 300% in some cases. We had several discussions with laboratory personnel, risk assessors, and EPA technical staff to help reconcile higher than expected RPDs and identified the following complicating factors:

- Due to the heterogeneity of the soil samples (i.e. the percentage of glass, organics, and other deleterious materials), securing a representative sample that could be replicated in the laboratory was difficult at best.
- The laboratory reported the detection of (what appeared to be) fragments of capacitor paper that likely contributed to higher than actual PCB concentrations.

Recognizing that there were significant variations in the results and matrix factors beyond our control, we implemented the following conservative approach:

1) Where PCB concentrations exceeding 50 ppm were detected, we directed over-excavation of the area to sample locations (in each direction) where results less than 50 ppm were detected.
2) When the laboratory suspected the presence of non-1254 Aroclor PCBs, we either proceeded with homologue analysis by Method 680 or simply assumed the sample contained a PCB concentration > 50 ppm and disposed of the remediation waste accordingly; and,
3) Where duplicate sample results were available, disposal decisions were based upon the higher detected concentration.

2.4.4 Method Blanks

Ottawa sand samples were run through all extraction and clean-up steps to confirm that the analytical instruments were free from contamination. The frequency was one per 20 samples or for each discrete run with the instrument. In virtually all method blanks, results for PCB analysis were non-detect.

3.0 CLEANUP PLAN

3.1 Schedule

Construction of the pile caps and grade beams is underway. The construction contract has provisions for installation of a permeable soil cap, construction of the building slab (with gas vapor barrier), and installation of granular materials and pavement that will comprise the "exposure management barrier".

Final construction of all components of the exposure management barrier is expected to be completed by August 31, 2006.

3.2 Disposal Technology

Fill material requiring excavation, disposal and/or on-site reuse has been handled in accordance with the EPA Work Plan.

3.3 Engineered Controls

In areas where fill remains at the School Site, the following engineering controls (exposure management barriers) and institutional controls (Activity and Use Limitation) will be implemented during or subsequent to construction activities:

3.3.1 Building Footprint

To protect on-site workers that will work on pile caps and grade beams (within the building footprint), the following provisions have been implemented. Upon completion of a pile cap(s), PCB remediation waste will be placed by appropriately trained workers into the remaining pile cap excavation area to a depth of six inches below the top of the pile cap. A geotextile barrier fabric be installed directly over the waste and then covered with a minimum of six inches of clean granular fill material. Non-OSHA-trained workers will then be permitted to perform grade beam form work.

Upon completion of grade beams, additional PCB remediation waste will be backfilled in the area of the grade beam to a depth of approximately two feet below the bottom of the building slab. A geotextile barrier fabric will be installed directly over the waste material and then six to eight inches of clean granular fill material will be placed on top of the fabric. Next, a geotextile fabric will be placed and a gas vapor barrier and passive venting system will be installed. A total of eight passive vent pipes have been provided for in the Phase III Contract Documents, as indicated on Drawing A9.5 (Figure 4).

To effect a vapor tight seal between the grade beams and the adherence geotextile, 80 dry mils of the gas vapor membrane will be applied as shown in Figure 4 Typical 3. The gas vapor membrane will be applied above the grade beams using a spray-on technology prior to pouring of the concrete slab. Refer to Attachment B for gas vapor barrier technical specifications. Refer to Figures 3.1 and 3.2 for a depiction of the sub slab and slab construction details.

3.3.2 Utility Corridors

Clean utility corridors are being created to prevent exposure of future construction or utility workers to fill material remaining at the Site. In these corridors, fill has been removed, properly disposed off-Site in accordance with the EPA Work Plan and applicable state and federal regulations, and replaced with clean granular material. The specification for backfill materials included in the Contract Documents is included as Attachment G.

3.3.3 Landscaped Areas

In landscaped areas outside of the new building footprint (see Figure 6):

- Fill material will be removed as necessary to make room for three feet of clean material beneath final grade;
- Separation geotextile will be placed over the remaining fill;
- A 12” +/- layer of granular material will be placed over the separation geotextile;
- Warning barrier will be placed;
- A 2’ +/- layer of granular material will be placed over the warning barrier to create a minimum of 3’ of granular material over the separation fabric; and,
- Landscaping will be established over the granular material.

3.3.4 Paved Areas

In developed areas outside of the new building footprint (see Figure 5):

- Fill material will be removed as necessary to make room for 2 feet of clean material beneath the paved surface;
- Separation geotextile will be placed over the remaining fill;
- A minimum of 15 inches of granular material will be placed over the separation geotextile; and
- 6 inches of crushed stone will be placed over the granular material.
- A minimum of 3 inches of pavement will be placed over the crushed stone.

3.3.5 Embankment

Embankments (edges of fill material) have been stabilized at a slope of 2:1 to 3:1 with three feet of clean soil overlying in-place contaminated material. The same geotextile fabric and warning barrier described above have been or will be installed at all of the stabilized embankment areas.

3.3.6 Long-term Monitoring and Maintenance

A Long-term Cap Monitoring Plan is included as Attachment E. An Environmental Monitoring Plan addressing indoor air and groundwater monitoring is included as Attachment F.

3.4 Activity and Use Limitation

An Activity and Use Limitation (AUL) will be placed on the property to require maintenance of the building slab, paved surfaces, and landscaped areas discussed above and to prevent penetration of these features without the oversight by a Massachusetts Licensed Site Professional (LSP). A Draft AUL is included as Attachment A.

4.0 HUMAN HEALTH RISK CHARACTERIZATION

This Section presents a qualitative risk characterization for the School Site and its future use as the New Keith Middle School. The objective of the human health risk characterization is to assess if Site conditions after development pose a potential health risk to humans.

4.1 Hazard Identification

4.1.1 Constituents of Concern

Constituents of concern (COCs) for the human health risk characterization include the following:

- Acenaphthene
- Acenaphthylene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Chrysene
- Dibenzo(a,h)anthracene
- Dibenzofuran
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- 2-Methylnaphthalene
- Naphthalene
- Phenanthrene
- Pyrene
- PCBs (as Aroclor 1254)
- Total petroleum hydrocarbons
- Arsenic
- Barium
- Lead

The rationale for excluding other detected constituents is presented on Table 1.

4.1.2 Environmental Fate and Transport Characteristics

The Environmental Monitoring Plan included as Attachment E includes provisions for monitoring transport of COCs by solubilization and volatilization.

Solubilization

Table 2 summarizes chemical properties that describe the potential environmental fate and transport of the COCs and ranks them according to tendency to solubilize in water, volatilize, and desorb from soil particles. The majority of the COCs are slightly soluble or not soluble, very slightly volatile or non-volatile, and slightly or hardly mobile or immobile. This indicates that these COCs have a very low migration potential and will be easily contained within the exposure management barriers.

A few COCs are listed as readily soluble (acenaphthylene, 2-methylnaphthalene, and naphthalene), slightly volatile (2-methylnaphthalene, and naphthalene) and moderately mobile (naphthalene). However, these constituents currently meet Method 1 S-3 soil standards; in fact, the maximum detected concentration of these COCs meet their most stringent applicable Method 1 soil standard (acenaphthylene: 100 mg/kg; 2-methylnaphthalene: 500 mg/kg; naphthalene: 200 mg/kg).

COCs in the fill material are not expected to adversely impact groundwater, and consequently not expected to migrate to the wetlands.

Volatilization

As discussed in Section 2.2.3, soil gas results were evaluated for the potential to adversely impact indoor air or an overlying building with no vapor barrier due to vapor diffusion into the building. The conclusion of the evaluation is that no significant risk to human health is posed by measured soil gas concentrations.

The gas vapor barrier to be installed across the entire building footprint will provide further protection against exposure to COCs through volatilization.

Erosion

Due to the engineered barriers (soil cap, asphalt cap, building), which will be maintained in accordance with the Activity and Use Limitation, no fill material will be present at the ground surface. Therefore, surface runoff will not be a migration pathway.

Furthermore, the Storm Water Pollution Prevention Plan (Attachment H) incorporates storm water management, stabilization practices, erosion and sediment control, and spill prevention. Hay bales and silt fences are in place, as shown in Figure 5 (detail 1/L6), along the toe of the entire embankment, Hathaway Boulevard, and other resource areas as shown in Figure 8.

Similarly, the engineered barriers will preclude the potential for entrainment of contaminated soil in the air. During construction activities in which contaminated material is exposed to the air, dust monitoring activities are conducted in accordance with the Soil Management and Dust Monitoring Section of the Work Plan as well as Work Plan Attachment O (Proposed Waste and Regulated Soil Removal Plan).

4.2 Exposure Assessment

Human receptors potentially present at the future Keith Middle School include the following:

- Students
- School employees
- Visitors
- Municipal employees (such as persons from public works, the water department, etc.)

The exposure management barriers and activity and use limitation (AUL) to be established at the school will prevent students, school employees, and visitors from regularly contacting underlying fill material and will also prohibit soil disturbance activities by municipal workers or similar groups. Therefore, exposure to students, school employees, visitors, or municipal workers to fill underlying exposure management barriers is incomplete.

Intrusion into fill material underneath the exposure management barriers could only result from unintended breaching of the exposure management barriers or from prohibited activities by unauthorized persons on the Site. To contact in-place fill material, a person would need to dig through the building foundation, three feet of clean material, or paving and two feet of clean material; a gravel layer; and a geotextile fabric layer. This scenario is considered highly unlikely.

Current Worker Exposure
ESS Group, Inc. (ESS) revised risk-based air concentrations (RBACs) for PCBs in inhalable particles in air, protective of on-Site construction workers and off-site residents. The approach and assumptions used to derive the RBACs, including all risk calculations are documented in a letter dated May 17, 2004. The conclusion of the assessment is that a concentration of 404 µg inhalable particles per m^3 air is protective of both receptor groups and both potential carcinogenic and non-carcinogenic health risks. Soil management and dust monitoring procedures are discussed further in the EPA Work Plan.

To limit the exposure of form workers under the current construction contract, coated geotextile fabric was installed directly over the waste and then covered with a minimum of six inches of clean granular fill material before non-OSHA-trained workers were permitted to perform grade beam form work.

Future Student-Teacher Exposure
Future developed portions of the Site, including the new school, and landscaped, parking, and associated open areas, will be managed by engineered barriers and structures and supporting land use restrictions as discussed in Section 3 above. These features will prevent students, school employees, or others from contacting underlying fill material and will prohibit soil disturbance activities. Therefore, exposure to people on future developed portions of the Site will be incomplete and is not assessed quantitatively.

Future Worker Exposure
Clean corridors have been established for utility installation and repair. Unless otherwise approved by a Massachusetts LSP, the AUL will limit excavation to within clean corridors to be performed by only authorized personnel.

4.3 Risk Characterization

The exposure management barriers to be established at the future Keith Middle School will effectively prevent potential human receptors from contacting COCs present in the in-place fill material. The properties of the COCs indicate that the COCs will be effectively controlled by the exposure management barriers. The AUL will provide a framework for ensuring that the exposure management barriers will be maintained and that persons are responsible for Site management. Based on these factors, future exposure of people to COCs present in the in-place fill material underneath the exposure management barriers is incomplete, and no health risks are posed.

5.0 WRITTEN CERTIFICATION

Pursuant to §761.61(a)(3)(i)(E), Scott Alfonse, as a representative of the City of New Bedford and the party conducting the cleanup, hereby certifies that all sampling plans, sample collection procedures, sample preparation procedures, extraction procedures, and instrumental/chemical analysis procedures used to assess or characterize the PCB contamination at the cleanup site, are on file at:

BETA Group, Inc.
315 Norwood Park South
Norwood, MA 02062

And are available for EPA inspection.

City of New Bedford

Scott Alfonse

Director of Environmental Stewardship

5/9/05

Date

6.0 REFERENCES

CIS Envirofate Database as referenced in
http://www.dep.state.pa.us/physicalproperties/_cgi-bin/CPP_Search.idc

CRC Handbook of Chemistry and Physics as referenced in
http://www.dep.state.pa.us/physicalproperties/ _cgi-bin/CPP_Search.idc

Groundwater Chemicals Desk Reference as referenced in
http://www.dep.state.pa.us/physicalproperties/ _cgi-bin/CPP_Search.idc

Massachusetts Department of Environmental Protection Bureau of Waste Site Cleanup (MA DEP BWSC) (May 1999). Guidance on Implementing Activity and Use Limitations. Interim Final Policy #WSC 99-300.

Massachusetts Department of Environmental Protection (MADEP) (undated) Documentation For the Cancer Inhalation Unit Risk Value for Tetrachloroethylene.

MADEP (2002). Implementation of MADEP VPH/EPH Approach, Final Policy. October.
NIOSH Pocket Guide to Chemical Hazards (www.cdc.gov/niosh/npg/npg.html).

Shah and Singh (1988). Environ. Sci. Technol. Vol. 22, No. 12, 1381-1388.

Total Petroleum Hydrocarbon Criteria Working Group (1998). Composition of Petroleum Mixtures. Amherst Scientific Publishing. November.

United Nations Food and Agriculture organization (FAO) (2000). Assessing Soil Contamination - A Reference Manual.

U.S. Environmental Protection Agency (U.S. EPA) (2005) Integrated Risk Information System (IRIS) (www.epa.gov/iris)

U.S. Environmental Protection Agency (U.S. EPA (2005). Region 9 Preliminary Remediation Goals. (http://www.epa.gov/region09/waste/sfund/prg/files/04prgtable.pdf). U.S. EPA (2004).

U.S. EPA (2005) Region 9 Preliminary Remediation Goal Tables. (www.epa.gov/region09/ waste/sfund/prg/index.htm)

U.S. EPA (2003). Users Guide for Evaluating Subsurface Vapor Intrusion into Buildings. June.

U.S. EPA (1998). Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Peer Review Draft. EPA-530-D-98-001A, July.

U.S. EPA (1998). 40 CFR 761.61. "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions." *Code of Federal Regulations*.

U.S. EPA (1994). ChemDat8 Users Guide. EPA453/C-94-080B, November.

U.S. EPA (1991). Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03, March.

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[1] Acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, naphthalene, phenanthrene, pyrene and the phthalic acid esters butylbenzylphthalate, di-n-butylphthalate, and bis(2-ethylhexyl)phthalate.

[2] The analytical laboratory also converted the reported concentrations to 2378-TCDD TEqs, but used an earlier toxicity equivalency scheme, so reported slightly different numbers.

[3] Conventional exposure parameters for an adult worker (U.S. EPA 1991); who is anticipated to have the longest exposure duration of users of the future building. This will also be protective of exposure of typical students.

REFER TO LISTED CONSTITUENTS OF CONCERN OUTLINED IN THE TEXT.

Table 1

Summary of Detected Constituents in Fill Material

Table 2

Properties of Constituents of Concern

TABLE 2 Revision 1
PROPERTIES OF CONSTITUENTS OF CONCERN
McCoy Field
New Bedford, Massachusetts

Constituent	Water Solubility (S) (mg/L)		Relative Solubility[6]	Vapor Pressure (VP) (atm)		Henry's Law Constant (H) (cm^3/cm^3)		Relative Volatility [7]	Log Organic Carbon/Water Partition Coefficient (Log K_{oc}) (cm^3/g)		Relative Mobility [8]
Acenaphthene	3.8	[1]	Moderately soluble	1.50E-05	[1]	4.91E-03	[1]	very slightly volatile	3.4	[1]	slightly mobile
Acenaphthylene	16.1	[1]	Readily soluble	4.09E-05	[1]	3.39E-03	[1]	very slightly volatile	3.4	[1]	slightly mobile
Anthracene	0.045	[1]	Not soluble	7.68E-07	[1]	1.60E-03	[1]	very slightly volatile	3.9	[1]	slightly mobile
Benzo(a)anthracene	0.011	[1]	Not soluble	5.98E-09	[1]	2.34E-04	[1]	very slightly volatile	5.0	[1]	hardly mobile
Benzo(a)pyrene	0.0038	[1]	Not soluble	2.10E-10	[1]	1.86E-05	[1]	non-volatile	5.1	[1]	immobile
Benzo(b)fluoranthene	0.0015	[1]	Not soluble	6.67E-08	[1]	6.46E-06	[9]	non-volatile	4.9	[1]	hardly mobile
Benzo(g,h,i)perylene	0.0003	[1]	Not soluble	2.22E-10	[1]	3.03E-05	[1]	non-volatile	5.5	[1]	immobile
Benzo(k)fluoranthene	0.0008	[1]	Not soluble	4.07E-11	[1]	6.46E-06	[1]	non-volatile	5.1	[1]	immobile
Chrysene	0.0015	[1]	Not soluble	1.06E-09	[1]	1.80E-04	[1]	very slightly volatile	4.9	[1]	hardly mobile
Dibenzo(a,h)anthracene	0.0005	[1]	Not soluble	1.33E-08	[1]	3.07E-06	[1]	non-volatile	5.7	[1]	immobile
Dibenzofuran	6.56	[2]	Moderately soluble	3.46E-06	[3]	4.50E-03	[2]	very slightly volatile	3.9	[4]	slightly mobile
Fluoranthene	0.26	[1]	Slightly soluble	8.61E-08	[1]	4.17E-04	[1]	very slightly volatile	4.4	[1]	hardly mobile
Fluorene	1.9	[1]	Moderately soluble	7.06E-06	[1]	3.19E-03	[1]	very slightly volatile	3.6	[1]	slightly mobile
Indeno(1,2,3-cd)pyrene	0.062	[1]	Not soluble	1.00E-09	[1]	2.07E-11	[1]	non-volatile	5.9	[1]	immobile
2-Methylnaphthalene	25	[1]	Readily soluble	1.11E-04	[1]	2.07E-02	[1]	slightly volatile	3.3	[1]	slightly mobile
Naphthalene	31	[1]	Readily soluble	3.63E-04	[1]	1.74E-02	[1]	slightly volatile	2.9	[1]	moderately mobile
Phenanthrene	1.1	[1]	Moderately soluble	1.12E-06	[1]	1.31E-03	[1]	very slightly volatile	3.9	[1]	slightly mobile
Pyrene	0.132	[1]	Slightly soluble	1.17E-07	[1]	3.71E-04	[1]	very slightly volatile	4.4	[1]	hardly mobile
PCBs (as Aroclor 1254)	0.01	[5]	Not soluble	1.16E-07	[5]	1.55E-01	[5]	very slightly volatile	6.0	[5]	immobile
Total petroleum hydrocarbons	Mixture										
Arsenic	NA		varies	NA		NA		non-volatile	NA		varies
Barium	NA		varies	NA		NA		non-volatile	NA		varies
Lead	NA		varies	NA		NA		non-volatile	NA		varies

NA = Not applicable or not available.

1. Total Petroleum Hydrocarbon Criteria Working Group (1998). Composition of Petroleum Mixtures. Amherst Scientific Publishing.
2. CRC Handbook of Chemistry and Physics as referenced in http://www.dep.state.pa.us/physicalproperties/_cgi-bin/CPP_Search.idc
3. Groundwater Chemicals Desk Reference as referenced in http://www.dep.state.pa.us/physicalproperties/_cgi-bin/CPP_Search.idc
4. CIS Envirofate Database as referenced in http://www.dep.state.pa.us/physicalproperties/_cgi-bin/CPP_Search.idc
5. U.S. EPA (1998). Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Peer Review Draft. EPA-530-D-98-001A, July.
6. Solubility relative ranking [FAO (2000). Assessing Soil Contamination - a Reference Manual.

Solubility (mg/L at 20 °C)	Classification
<0.10	Not soluble
0.1–1	Slightly soluble
1–10	Moderately soluble
10–100	Readily soluble
>100	Highly soluble

7. Volatility relative ranking (source)

VP (atm)		H (cm^3/cm^3)	
< 0.001	and	< 5E-05	non-volatile
< 0.001	and	5E-03 < H < 5E-05	very slightly volatile
< 0.001	and	5E-01 < H < 5E-03	slightly volatile

8. Mobility relative ranking [FAO (2000). Assessing Soil Contamination - a Reference Manual]

Log K_{oc}	Classification
<1	Highly mobile
1–2	Mobile
2–3	Moderately mobile
3–4	Slightly mobile
4–5	Hardly mobile
>5	Immobile

9. Assumed same as benzo(k)fluoranthene.

Table 3

Summary of Soil Analyses for Chlorinated Dibenzo-p-dioxins and Dibenzofurans

TABLE 3
SUMMARY OF SOIL ANALYSES FOR
CHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS
McCoy Field
New Bedford, Massachusetts

Sample ID	2,3,7,8-TCDD pg/g			1,2,3,7,8-PeCDD pg/g			1,2,3,4,7,8-HxCDD pg/g			1,2,3,6,7,8-HxCDD pg/g			1,2,3,7,8,9-HxCDD pg/g			1,2,3,4,6,7,8-HpCDD pg/g		
TCDD TEF_{DFP}-WHO_{98} --->	**1**		**TEQ**	**1**		**TEQ**	**0.1**		**TEQ**	**0.1**		**TEQ**	**0.1**		**TEQ**	**0.01**		**TEQ**
Q4-A & B	0.2	U	0.1	0.3	U	0.15	1.4	J	0.14	6.2		0.62	5.2		0.52	117		1.17
Q16 A & B	*0.8*	J	0.8	2.2	J	2.2	3.4	J	0.34	16.8		1.68	10.2		1.02	629		6.29
Q24 A & B	1.4	J	1.4	3.6	J	3.6	6.7		0.67	44.2		4.42	23.5		2.35	1,790		17.9
Q37 A, B, &C	*0.68*	J	0.68	2.1	J	2.1	3.6	J	0.36	9.3		0.93	9		0.9	237		2.37
Duplicate 11	2.8		2.8	6		6	5.2		0.52	34.1		3.41	24.1		2.41	1,310		13.1
Duplicate 13	0.95	J	0.95	3.2	J	3.2	2.6	J	0.26	9		0.9	7.9		0.79	146		1.46
Q6-Embankment A & B	0.66	J	0.66	2.5	J	2.5	2.3	J	0.23	8		0.8	7		0.7	129		1.29
Q11-Embankment A &	0.4	J	0.4	1.8	J	1.8	2.2	J	0.22	5.8		0.58	6		0.6	106		1.06
Arithmetic Mean Concentration [1]			0.97			2.69			0.34			1.67			1.16			5.58
Maximum Detected Concentration			2.8			6			0.67			4.42			2.41			17.9
Method 1 S-1 Soil standard [2]			4			4			4			4			4			4
Method 1 S-2 Soil standard [2]			6			6			6			6			6			6
Method 1 S-3 Soil standard [2]			20			20			20			20			20			20
Upper Concentration Limit [3]			200			200			200			200			200			200

pg/g = picograms per grams (parts per trillion).
U = Undetected at quantitation limit presented.
J = Estimated below calibration range.
C = Value reported from confirmatory analysis.
D = Value reported from dilution analysis.
X = Interference from diphenyl ethers.
TEF = Toxicity equivalency factor.
TEQ = Toxicity equivalents.
TCDD=Tetrachlorodibenzo-p-dioxin.
TCDF = Tetrachlorodibenzofuran.
PeCDD = Pentachlorodibenzo-p-dioxin.
PeCDF = Pentachlorodibenzofuran.
HxCDD = Hexachlorodibenzo-p-dioxin.
HxCDF = Hexachlorodibenzofuran.
HpCDD = Heptachlorodibenzo-p-dioxin.
HpCDF = Heptachlorodibenzofuran.
OCDD = Octachlorodibenzo-p-dioxin.
OCDF = Octachlorodibenzofuran.
Value in italics = Estimated maximum possible concentration (EMPC).
1. Non-detections included at 1/2 quantitation limit.
2. 310 CMR 40.0975(a), (b), (c).
3. 310 CMR 40.0996(7).

TABLE 3
SUMMARY OF SOIL ANALYSES FOR
CHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS
McCoy Field
New Bedford, Massachusetts

Sample ID	1,2,3,4,6,7,8,9-OCDD pg/g			2,3,7,8-TCDF pg/g			1,2,3,7,8-PeCDF pg/g			2,3,4,7,8-PeCDF pg/g		1,2,3,4,7,8-HxCDF pg/g		1,2,3,6,7,8-HxCDF pg/g	
TCDD TEF_{DFP}-WHO_{98} --->	0.0001		TEQ	0.1		TEQ	0.05		TEQ	0.5	TEQ	0.1	TEQ	0.1	TEQ
Q4-A & B	1,260		0.126	8.2	C	0.82	0.1	U	0.0025	14.7	7.35	93.7	9.37	33.3	3.33
Q16 A & B	4,690	D	0.469	11.1	C	1.11	0.1	U	0.0025	11.5	5.75	36.5	3.65	17	1.7
Q24 A & B	12,160	D	1.216	15.7	C	1.57	0.1	U	0.0025	16.3	8.15	44.2	4.42	18.9	1.89
Q37 A, B, &C	3,020		0.302	5.2	C	0.52	0.08	U	0.002	5.6	2.8	23.7	2.37	9.9	0.99
Duplicate 11	10,210	D	1.021	18.4	C	1.84	0.2	U	0.005	19.3	9.65	51.9	5.19	22.2	2.22
Duplicate 13	1,400		0.14	13	C	1.3	0.1	U	0.0025	17.6	8.8	34.4	3.44	16.8	1.68
Q6-Embankment A & B	1,190		0.119	11.2	C	1.12	0.6	U	0.015	9.9	4.95	29.6	2.96	13.5	1.35
Q11-Embankment A &	1,640		0.164	5.3	C	0.53	0.05	U	0.00125	5.8	2.9	11.4	1.14	6.2	0.62
Arithmetic Mean Concentration [1]			0.44			1.10			0.004		6.29		4.07		1.72
Maximum Detected Concentration			1.22			1.84			0.015		9.65		9.37		3.33
Method 1 S-1 Soil standard [2]			4			4			4		4		4		4
Method 1 S-2 Soil standard [2]			6			6			6		6		6		6
Method 1 S-3 Soil standard [2]			20			20			20		20		20		20
Upper Concentration Limit [3]			200			200			200		200		200		200

pg/g = picrograms per grams (parts per trillion).
U = Undetected at quantitation limit presented.
J = Estimated below calibration range.
C = Value reported from confirmatory analysis.
D = Value reported from dilution analysis.
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TEF = Toxicity equivalency factor.
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HxCDF = Hexachlorodibenzofuran.
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Value in italics = Estimated maximum possible concentration (EMPC).
1. Non-detections included at 1/2 quantitation limit.
2. 310 CMR 40.0975(a), (b), (c).
3. 310 CMR 40.0996(7).

TABLE 3
SUMMARY OF SOIL ANALYSES FOR
CHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS
McCoy Field
New Bedford, Massachusetts

Sample ID	2,3,4,6,7,8-HxCDF pg/g		1,2,3,7,8,9-HxCDF pg/g			1,2,3,4,6,7,8-HpCDF pg/g		1,2,3,4,7,8,9-HpCDF pg/g			1,2,3,4,6,7,8,9-OCDF pg/g		Sample Total TCDD pg/g
TCDD TEF_{DFP}-WHO_{98} --->	0.1	TEQ	0.1		TEQ	0.01	TEQ	0.01		TEQ	0.0001	TEQ	
Q4-A & B	19.1	1.91	*5.8*	X	0.58	76.3	0.763	27.3		0.273	156	0.0156	27.2
Q16 A & B	16.4	1.64	*7.5*	X	0.75	172	1.72	12.1		0.121	276	0.0276	29.3
Q24 A & B	20.2	2.02	*8.6*	X	0.86	346	3.46	20.3		0.203	1,320	0.132	54.3
Q37 A, B, &C	8.4	0.84	*4.2*	XJ	0.42	99.7	0.997	8.2		0.082	220	0.022	16.7
Duplicate 11	22.4	2.24	*10.4*	X	1.04	310	3.1	18.2		0.182	628	0.0628	54.8
Duplicate 13	20.9	2.09	*10.9*	X	1.09	108	1.08	8.5		0.085	128	0.0128	27.3
Q6-Embankment A & B	14.8	1.48	*10.1*	X	1.01	88.8	0.888	6.2		0.062	100	0.01	20.1
Q11-Embankment A &	8.5	0.85	*3.8*	XJ	0.38	45.6	0.456	3.3	J	0.033	58.4	0.00584	11.7
Arithmetic Mean Concentration [1]		1.63			0.77		1.56			0.13		0.036	30.2
Maximum Detected Concentration		2.24			1.09		3.46			0.27		0.132	54.8
Method 1 S-1 Soil standard [2]		4			4		4			4		4	4
Method 1 S-2 Soil standard [2]		6			6		6			6		6	6
Method 1 S-3 Soil standard [2]		20			20		20			20		20	20
Upper Concentration Limit [3]		200			200		200			200		200	200

pg/g = picrograms per grams (parts per trillion).
U = Undetected at quantitation limit presented.
J = Estimated below calibration range.
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X = Interference from diphenyl ethers.
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TCDD=Tetrachlorodibenzo-p-dioxin.
TCDF = Tetrachlorodibenzofuran.
PeCDD = Pentachlorodibenzo-p-dioxin.
PeCDF = Pentachlorodibenzofuran.
HxCDD = Hexachlorodibenzo-p-dioxin.
HxCDF = Hexachlorodibenzofuran.
HpCDD = Heptachlorodibenzo-p-dioxin.
HpCDF = Heptachlorodibenzofuran.
OCDD = Octachlorodibenzo-p-dioxin.
OCDF = Octachlorodibenzofuran.
Value in italics = Estimated maximum possible concentration (EMPC).
1. Non-detections included at 1/2 quantitation limit.
2. 310 CMR 40.0975(a), (b), (c).
3. 310 CMR 40.0996(7).

Table 4

Results of Groundwater Analysis
Samples Collected 10-31-02

McCoy Field
Results of Groundwater Analysis
Samples Collected October 31, 2002

Parameter	Method 1 Groundwater		Sample Location			
	GW-3	Units	TB/OW-22	TB/OW-2	TB/OW-18	TB/OW-6
Total Metals						
Antimony, Total	300	ug/l	ND	ND	ND	ND
Arsenic, Total	400	ug/l	ND	ND	ND	ND
Barium, Total	30000	ug/l	260	80	140	1300
Beryllium, Total	50	ug/l	ND	ND	ND	ND
Cadmium, Total	10	ug/l	ND	ND	ND	ND
Chromium, Total	2000	ug/l	ND	ND	ND	ND
Lead, Total	30	ug/l	ND	ND	ND	ND
Nickel, Total	80	ug/l	ND	ND	ND	ND
Selenium, Total	80	ug/l	ND	ND	ND	ND
Silver, Total	7	ug/l	ND	ND	ND	ND
Thallium, Total	400	ug/l	ND	ND	ND	ND
Vanadium, Total	2000	ug/l	ND	ND	10	ND
Zinc, Total	900	ug/l	ND	ND	ND	ND
Volatile Organic Compounds (VOCs)-8260						
Benzene	7000	ug/l	ND	ND	ND	0.76
Toluene	50000	ug/l	1.7	1.8	1.4	1.9
Ethylbenzene	4000	ug/l	ND	ND	ND	ND
Vinyl chloride	40000	ug/l	ND	ND	ND	ND
Methyl tert butyl ether	50000	ug/l	1.1	ND	ND	ND
Total Xylenes	50000	ug/l	ND	ND	ND	ND
Hexachlorobutadiene	90	ug/l	ND	ND	ND	ND
Naphthalene	6000	ug/l	2.5	ND	ND	6.5
Semi-Volatile Organic Compounds (SVOCs)-8270						
Hexachlorobenzene	40	ug/l	ND	ND	ND	ND
1,4-Dichlorobenzene	8000	ug/l	ND	ND	ND	ND
Hexachlorobutadiene	90	ug/l	ND	ND	ND	ND
Benzo(a)anthracene	3000	ug/l	ND	ND	ND	ND
Benzo(a)pyrene	3000	ug/l	ND	ND	ND	ND
Benzo(b)fluoranthene	3000	ug/l	ND	ND	ND	ND
Benzo(k)fluoranthene	3000	ug/l	ND	ND	ND	ND
Chrysene	3000	ug/l	ND	ND	ND	ND
Dibenzo(a,h)anthracene	3000	ug/l	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	3000	ug/l	ND	ND	ND	ND
Pentachlorophenol	80	ug/l	ND	ND	ND	ND
Polycyclic Aromatic Hydrocarbons (PAHs)-8270M						
Acenaphthene	5000	ug/l	ND	ND	ND	ND
Fluoranthene	200	ug/l	ND	ND	ND	ND
Naphthalene	6000	ug/l	ND	ND	ND	3.6
Benzo(a)anthracene	3000	ug/l	ND	ND	ND	ND
Benzo(a)pyrene	3000	ug/l	ND	ND	ND	ND
Benzo(b)fluoranthene	3000	ug/l	ND	ND	ND	ND
Benzo(k)fluoranthene	3000	ug/l	ND	ND	ND	ND
Chrysene	3000	ug/l	ND	ND	ND	ND
Acenaphthylene	3000	ug/l	ND	ND	ND	ND
Anthracene	3000	ug/l	ND	ND	ND	ND
Benzo(ghi)perylene	3000	ug/l	ND	ND	ND	ND

McCoy Field
Results of Groundwater Analysis
Samples Collected October 31, 2002

Parameter	Method 1 Groundwater		Sample Location			
	GW-3	Units	TB/OW-22	TB/OW-2	TB/OW-18	TB/OW-6
Fluorene	3000	ug/l	ND	ND	ND	ND
Phenanthrene	50	ug/l	ND	ND	ND	ND
Dibenzo(a,h)anthracene	3000	ug/l	ND	ND	ND	ND
Indeno(1,2,3-cd)Pyrene	3000	ug/l	ND	ND	ND	ND
Pyrene	3000	ug/l	ND	ND	ND	ND
2-Methylnaphthalene	3000	ug/l	ND	ND	ND	ND
Polychlorinated Biphenyls (PCBs)						
Aroclor 1221	0.3	ug/l	ND	ND	ND	ND
Aroclor 1232	0.3	ug/l	ND	ND	ND	ND
Aroclor 1242/1016	0.3	ug/l	ND	ND	ND	ND
Aroclor 1248	0.3	ug/l	ND	ND	ND	ND
Aroclor 1254	0.3	ug/l	ND	ND	ND	ND
Aroclor 1260	0.3	ug/l	ND	ND	ND	ND
Extractable Petroleum Hydrocarbons (EPH)						
C9-C18 Aliphatics	20000	ug/l	ND	ND	ND	ND
C19-C36 Aliphatics	20000	ug/l	ND	ND	ND	ND
C11-C22 Aromatics, Unadjusted	30000	ug/l	ND	ND	ND	ND

ND-not detected.

Table 5

Evaluation of Soil Gas Concentrations

TABLE 5
EVALUATION OF SOIL GAS CONCENTRATIONS
McCoy Field
New Bedford, Massachusetts

Sample Identification	Conversion Factor[1]	SG-1		SG-2		SG-3		SG-4		SG-5		SG-6	
	$[(mg/m^3)/(ppb_v)]$	ppb_v	$\mu g/m^3$	ppb_v	$\mu g/m^3$	ppb_v	$\mu g/m^3$	ppb_v	$\mu g/m^3$	ppb_v	$\mu g/m^3$	ppb_v	$\mu g/m^3$
Acetone	2.4	4.8	11.4	5.4	12.9	15	35.7	9.6	22.8	13	30.9	ND	ND
Benzene	3.2	0.6	2	1.6	5.1	0.9	2.7	ND	ND	ND	ND	8.5	27.1
1,3-Butadiene	2.2	ND	ND	10	22.1	9.5	21	ND	ND	34	75.1	233	515
2-Butanone (MEK)	3.0	ND	ND	2	5.9	ND	ND	3	8.9	ND	ND	88	260
Carbon Disulfide	3.1	1.1	3.4	1.2	3.7	ND	ND	ND	ND	ND	ND	0.6	2.0
Chloromethane	2.1	0.6	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cyclohexane	3.4	2.6	8.9	ND	ND	ND	ND	ND	ND	ND	ND	31	107
cis-1,2-Dichloroethene	4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	12	47.6
trans-1,2-Dichloroethene	4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.2	8.8
Dichlorodifluoromethane	5.0	0.7	3.3	0.6	3	ND	ND	ND	ND	ND	ND	17	84.2
Ethanol	1.9	ND	ND	81	153	144	272	615	1,162	ND	ND	ND	ND
Ethylbenzene	4.3	ND	ND	ND	ND	0.9	3.8	ND	ND	ND	ND	3.2	13.9
4-Ethyltoluene	4.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.8	3.9
Heptane	4.1	9.6	39.4	41	168	86	353	274	1,123	ND	ND	13	53.3
Hexane	3.5	5.2	18.4	ND	ND	ND	ND	ND	ND	ND	ND	63	222
Methy tert-Butyl Ether	3.6	ND	ND	2.6	9.4	ND	ND	ND	ND	2.9	10.4	ND	ND
4-Methyl-2-pentanone (MIBK)	4.1	ND	ND	5	20.5	8.6	35.3	ND	ND	ND	ND	ND	ND
Propene	1.7	158	272	21	36.1	38	65.4	ND	ND	ND	ND	1,031	1,774
Tetrachloroethene	6.8	ND	ND	0.9	6.3	9.7	65.8	3.5	23.7	ND	ND	ND	ND
Toluene	3.8	8.8	33.2	35	132	83	313	107	403	ND	ND	8.1	30.5
Trichloroethene	5.4	ND	ND	1.6	8.6	ND	ND	ND	ND	ND	ND	7.7	41.3
1,2,4-Trimethylbenzene	4.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2	5.9
Vinyl Chloride	2.6	2.9	7.4	ND	ND	ND	ND	ND	ND	ND	ND	93	238
Xylenes (total)	4.3	ND	ND	1.8	7.8	3.5	15.2	ND	ND	ND	ND	11.1	48.2
C5-C8 aliphatic hydrocarbons													
2-Methyl-1-pentene	3.4	ND	ND	7.2	24.8	12	41.3	ND	ND	ND	ND	ND	ND
Isobutane	2.4	21	49.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentane	3.0	4.8	14.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylpentane	3.5	9.9	34.9	ND	ND	7.9	27.8	27	95.2	ND	ND	ND	ND
3-Methylpentane	3.5	ND	ND	ND	ND	11	38.8	ND	ND	ND	ND	ND	ND
3,3-Dimethylpentane	4.1	3.5	14.3	19	77.9	26	106.6	82	336.1	ND	ND	ND	ND
2-Methylhexane	4.1	10	41.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3-Dimethylpentane	4.1	12	49.2	52	213.1	82	336.1	264	1082.0	ND	ND	13	53.3
3-Ethylpentane	4.1	ND	ND	32	131.2	52	213.1	163	668.1	ND	ND	ND	ND
2,3,4-Trimethylpentane	4.7	7.9	36.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Heptene	4.0	5.1	20.5	21	84.3	33	132.5	103	413.6	ND	ND	ND	ND
Methylcyclohexane	4.0	22	88.4	79	317.3	131	526.1	407	1634.5	ND	ND	ND	ND
2-Methylheptane	4.7	2.9	13.5	ND	ND	13	60.7	36	168.1	ND	ND	ND	ND
2,5-Dimethylhexane	4.7	ND	ND	6.5	30.8	ND	ND	ND	ND	ND	ND	ND	ND
1-Octene	4.6	ND	ND	7.3	33.5	ND	ND	39	178.8	ND	ND	ND	ND
1,2,4-Trimethylcyclopentane	4.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	11	50.5
2,4-Dimethylpentane	4.1	ND	ND	ND	ND	36	147.5	ND	ND	ND	ND	ND	ND
4-Methyl-1-hexene	4.0	ND	ND	ND	ND	ND	ND	42	168.6	ND	ND	ND	ND
2,4-Dimethylhexane	4.7	ND	ND	ND	ND	ND	ND	22	102.8	ND	ND	ND	ND
3-Methyl-hexane	4.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,2-Dimethylcyclohexane	4.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	17	78.0
TOTAL			362.8		912.8		1630.6		4847.8		0.0		181.8

TABLE 5
EVALUATION OF SOIL GAS CONCENTRATIONS
McCoy Field
New Bedford, Massachusetts

Sample Identification	SG-7		SG-8		SG-9		SG-10		Average Detected Concentration (excluding non-detections)
	ppb_v	$\mu g/m^3$	ppb_v	$\mu g/m^3$	ppb_v	$\mu g/m^3$	ppb_v	$\mu g/m^3$	$\mu g/m^3$
Acetone	ND	ND	6.1	14.5	40	95.2	3.8	9	29.1
Benzene	0.8	2.4	ND	ND	2.2	7	0.7	2.2	6.9
1,3-Butadiene	68	150	3.9	8.6	36	79.6	6.0	13.3	111
2-Butanone (MEK)	ND	ND	ND	ND	11	32.5	1.6	4.7	62.3
Carbon Disulfide	1.7	5.3	ND	ND	5.8	18	ND	ND	6.5
Chloromethane	ND	ND	0.7	1.4	0.7	1.5	0.7	1.4	1.4
Cyclohexane	ND	ND	ND	ND	4.6	15.8	ND	ND	43.8
cis-1,2-Dichloroethene	1.4	5.6	ND	ND	6.9	27.4	ND	ND	26.9
trans-1,2-Dichloroethene	ND	ND	ND	ND	0.9	3.5	ND	ND	6.1
Dichlorodifluoromethane	0.7	3.6	0.7	3.2	ND	ND	0.5	2.6	16.6
Ethanol	ND	ND	51	96.4	114	215	220	416	386
Ethylbenzene	0.7	3.0	ND	ND	0.9	4	1.1	4.8	5.9
4-Ethyltoluene	ND	ND	ND	ND	ND	ND	ND	ND	3.9
Heptane	36	148	25	103	71	291	99.0	406	298
Hexane	8.7	30.7	0.9	3.2	6.4	22.6	4.1	14.5	52
Methy tert-Butyl Ether	ND	ND	ND	ND	2.1	7.6	ND	ND	9.1
4-Methyl-2-pentanone (MIBK)	ND	ND	3.4	13.9	ND	ND	12.0	49.2	29.7
Propene	296	509	ND	ND	202	348	ND	ND	501
Tetrachloroethene	6.6	44.7	ND	ND	ND	ND	ND	ND	35.1
Toluene	42	158	37	139	75	283	123	464	217
Trichloroethene	2.1	11.3	ND	ND	2.0	10.7	ND	ND	18
1,2,4-Trimethylbenzene	ND	ND	ND	ND	1.2	5.9	ND	ND	5.9
Vinyl Chloride	8.6	22	ND	ND	13.0	33.3	ND	ND	75.2
Xylenes (total)	3.2	13.9	1.5	6.5	4.0	17.4	4.7	20.4	18.5
C5-C8 aliphatic hydrocarbons									
2-Methyl-1-pentene	ND	ND	ND	ND	12	41.3	ND	ND	
Isobutane	ND	ND	ND	ND	ND	ND	ND	ND	
Pentane	ND	ND	ND	ND	ND	ND	ND	ND	
2-Methylpentane	ND	ND	ND	ND	13	45.8	ND	ND	
3-Methylpentane	ND	ND	ND	ND	ND	ND	ND	ND	
3,3-Dimethylpentane	14	57.4	9.5	38.9	ND	ND	ND	ND	
2-Methylhexane	ND	ND	ND	ND	63	258.2	ND	ND	
2,3-Dimethylpentane	40	163.9	30	123.0	60	245.9	ND	ND	
3-Ethylpentane	27	110.7	19	77.9	41	168.0	ND	ND	
2,3,4-Trimethylpentane	ND	ND	ND	ND	ND	ND	ND	ND	
1-Heptene	17	68.3	12	48.2	25	100.4	ND	ND	
Methylcyclohexane	72	289.1	ND	ND	104	417.7	ND	ND	
2-Methylheptane	ND	ND	ND	ND	ND	ND	ND	ND	
2,5-Dimethylhexane	ND	ND	4.7	22.2	10	47.3	ND	ND	
1-Octene	8.2	37.6	ND	ND	11	50.4	ND	ND	
1,2,4-Trimethylcyclopentane	ND	ND	ND	ND	ND	ND	ND	ND	
2,4-Dimethylpentane	ND	ND	ND	ND	ND	ND	ND	ND	
4-Methyl-1-hexene	ND	ND	ND	ND	ND	ND	ND	ND	
2,4-Dimethylhexane	ND	ND	14	65.4	ND	ND	ND	ND	
3-Methyl-hexane	ND	ND	60	245.9	ND	ND	ND	ND	
trans-1,2-Dimethylcyclohexane	ND	ND	ND	ND	ND	ND	ND	ND	
TOTAL		727.0		621.5		1,375		ND	1,184

TABLE 5
EVALUATION OF SOIL GAS CONCENTRATIONS
McCoy Field
New Bedford, Massachusetts

Sample Identification	Indoor Air Attenuation Coefficient $(\alpha)^2$ (unitless)	Non-Cancer Intake Factor [4] (unitless)	Non-Cancer Exposure Point Concentration[13] $\mu g/m^3$	Inhalation Reference Concentration (mg/m^3)	Non-Cancer Hazard Index[14] (unitless)	Cancer Intake Factor [5] (unitless)	Cancer Exposure Point Concentration[13] $(\mu g/m^3)$	Cancer Inhalation Unit Risk $[(mg/m^3)^{-1}]$	Excess Lifetime Cancer Risk[15] (unitless)	Background Indoor Air Concentration[3] $(\mu g/m^3)$
Acetone	8.92E-04	2.28E-01	0.0059	3 [7]	0.000002	--	--	--	--	27
Benzene	7.67E-04	2.28E-01	0.0012	0.03 [6]	0.00004	8.15E-02	0.0004	0.0078 [6]	3E-09	21
1,3-Butadiene	1.11E-03	2.28E-01	0.0281	0.002 [6]	0.01	8.15E-02	0.01	0.03 [6]	3E-07	1.5 [10]
2-Butanone (MEK)	1.35E-04	2.28E-01	0.0019	5 [6]	0.0000004	--	--	--	--	42 [10]
Carbon Disulfide	8.28E-04	2.28E-01	0.0012	0.7 [6]	0.000002	--	--	--	--	--
Chloromethane	8.97E-04	2.28E-01	0.0003	0.09 [6]	0.000003	--	--	--	--	1.5 [10]
Cyclohexane	7.49E-04	2.28E-01	0.0075	6 [6]	0.000001	--	--	--	--	8.0
cis-1,2-Dichloroethene	7.01E-04	2.28E-01	0.0043	0.035 [7]	0.0001	--	--	--	--	4.1 [10]
trans-1,2-Dichloroethene	6.86E-04	2.28E-01	0.0010	0.07 [7]	0.00001	--	--	--	--	--
Dichlorodifluoromethane	6.64E-04	2.28E-01	0.0025	0.2 [7]	0.00001	--	--	--	--	1.7 [10]
Ethanol	8.90E-04	2.28E-01	0.0784	NA	--	--	--	--	--	--
Ethylbenzene	7.08E-04	2.28E-01	0.0010	1 [6]	0.000001	--	--	--	--	9.6
4-Ethyltoluene	6.11E-04	2.28E-01	0.0005	0.05 [11]	0.00001	--	--	--	--	--
Heptane	6.60E-04	2.28E-01	0.0449	0.2 [12]	0.0002	--	--	--	--	--
Hexane	1.05E-03	2.28E-01	0.0125	0.2 [6]	0.00006	--	--	--	--	--
Methy tert-Butyl Ether	1.64E-04	2.28E-01	0.0003	3 [6]	0.0000001	--	--	--	--	--
4-Methyl-2-pentanone (MIBK)	7.08E-04	2.28E-01	0.0048	3 [6]	0.000002	--	--	--	--	--
Propene	1.19E-03	2.28E-01	0.1358	NA	--	--	--	--	--	--
Tetrachloroethene	6.93E-04	2.28E-01	0.0056	0.035 [7]	0.0002	8.15E-02	0.002	0.0552 [8]	1E-07	11
Toluene	7.63E-04	2.28E-01	0.0378	0.4 [6]	0.00009	--	--	--	--	28.6
Trichloroethene	7.27E-04	2.28E-01	0.0030	0.035 [7]	0.00009	8.15E-02	0.001	0.11 [7]	1E-07	4.5
1,2,4-Trimethylbenzene	6.30E-04	2.28E-01	0.0008	0.006 [7]	0.0001	--	--	--	--	5.4
Vinyl Chloride	8.35E-04	2.28E-01	0.0143	0.1 [6]	0.0001	8.15E-02	0.005	0.0088 [6]	5E-08	0.03
Xylenes (total)	7.35E-04	2.28E-01	0.0031	0.1 [6]	0.00003	--	--	--	--	72.4
C5-C8 aliphatic hydrocarbons										
2-Methyl-1-pentene										
Isobutane										
Pentane										
2-Methylpentane										
3-Methylpentane										
3,3-Dimethylpentane										
2-Methylhexane										
2,3-Dimethylpentane										
3-Ethylpentane										
2,3,4-Trimethylpentane										
1-Heptene										
Methylcyclohexane										
2-Methylheptane										
2,5-Dimethylhexane										
1-Octene										
1,2,4-Trimethylcyclopentane										
2,4-Dimethylpentane										
4-Methyl-1-hexene										
2,4-Dimethylhexane										
3-Methyl-hexane										
trans-1,2-Dimethylcyclohexane										
TOTAL	7.32E-04	2.28E-01	0.1978	0.2 [7]	0.001	--	--	--	--	85 [9]

TABLE 5
EVALUATION OF SOIL GAS CONCENTRATIONS
McCoy Field
New Bedford, Massachusetts

Sample Identification	Conversion Factor[1]	SG-1		SG-2		SG-3		SG-4		SG-5		SG-6	
	[(mg/m^3)/(ppb$_v$)]	ppb$_v$	µg/m^3	ppb$_v$	µg/m^3	ppb$_v$	µg/m^3	ppb$_v$	µg/m^3	ppb$_v$	µg/m^3	ppb$_v$	µg/m^3
C9-C12 aliphatic hydrocarbons													
Decane	5.8	ND	ND	3.3	19.2	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylheptane	5.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.6	39.9
2,6-Dimethylheptane	5.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	16	83.9
1,2,4-Trimethylcyclohexane	5.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	19	98.1
1-Methyl-4-(1-methylethyl)cyclohexane	5.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	22	126.2
1,1,2,3-Tetramethylcyclohexane	5.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	59	340.8
4-Methyldecane	6.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	24	153.4
3-Methylnonane	5.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-Ethyl-2-methylheptane	5.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TOTAL			ND		19.2		ND		ND		ND		842.3
Miscellaneous													
2-Bromopentane	6.2	ND	ND	4.5	27.8	ND	ND	ND	ND	ND	ND	ND	ND
Cyclopentanone	3.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Limonene	5.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dimethyl disulfide	3.9	ND	ND	ND	ND	ND	ND	ND	ND	150	578	ND	ND
trans-Decahydronaphthalene	5.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	16	90.5
OVERALL TOTAL													

ppb$_v$ = parts per billion by volume.
µg/m^3 = micrograms per cubic meter.
ND = Not detected.
NC = Not calculated.
NA = Not available.
1. NIOSH Pocket Guide to Chemical Hazards or calculated as: [(mg/m^3)/(ppm) = MW/24.45].
2. Calculated values; see following spreadsheet.
3. Shah and Singh (1988). Environ. Sci. Technol. Vol. 22, No. 12, 1381-1388.
4. (8 hr/dy)(250 dy/yr)(25 yr)(1.14E-4 yr/hr)/25 yr
5. (8 hr/dy)(250 dy/yr)(25 yr)(1.14E-4 yr/hr)/70 yr
6. U.S. EPA (2005) IRIS (www.epa.gov/iris).
7. U.S. EPA (2005) Region 9 preliminary remediation goal tables.
8. MADEP (undated) Documentation For the Cancer Inhalation Unit Risk Value for Tetrachloroethylene.
9. MADEP (2002). Implementation of MADEP VPH/EPH Approach, Final Policy. October.
10. Value is 75th %-tile outdoor concentration.
11. Value for C9-C10 aromatic hydrocarbons (R7).
12. No value available;value for hexane applied.
13. (Avg soil gas conc)(atten. coeff.)(intake factor).
14. (Exposure Conc) / (1000)(Reference Conc).
15. (Exposure Conc)(Unit Risk)/(1000).

TABLE 5
EVALUATION OF SOIL GAS CONCENTRATIONS
McCoy Field
New Bedford, Massachusetts

Sample Identification	SG-7		SG-8		SG-9		SG-10		Average Detected Concentration (excluding non-detections)
	ppb_v	$\mu g/m^3$	ppb_v	$\mu g/m^3$	ppb_v	$\mu g/m^3$	ppb_v	$\mu g/m^3$	$\mu g/m^3$
C9-C12 aliphatic hydrocarbons									
Decane	23	133.9	ND	ND	ND	ND	ND	ND	
2,4-Dimethylheptane	ND	ND	ND	ND	ND	ND	ND	ND	
2,6-Dimethylheptane	ND	ND	ND	ND	ND	ND	ND	ND	
1,2,4-Trimethylcyclohexane	ND	ND	ND	ND	ND	ND	ND	ND	
1-Methyl-4-(1-methylethyl)cyclohexane	ND	ND	ND	ND	ND	ND	ND	ND	
1,1,2,3-Tetramethylcyclohexane	ND	ND	ND	ND	ND	ND	ND	ND	
4-Methyldecane	26	166.2	ND	ND	ND	ND	ND	ND	
3-Methylnonane	9.4	54.6	ND	ND	ND	ND	ND	ND	
3-Ethyl-2-methylheptane	9.5	55.3	ND	ND	ND	ND	ND	ND	
TOTAL		410.0		ND		ND		ND	424
Miscellaneous									
2-Bromopentane	ND	ND	ND	ND	ND	ND	ND	ND	28
Cyclopentanone	ND	ND	4.3	14.8	ND	ND	ND	ND	15
Limonene	ND	ND	ND	ND	3.6	20.1	ND	ND	20
Dimethyl disulfide	ND	ND	ND	ND	ND	ND	ND	ND	578
trans-Decahydronaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	90
OVERALL TOTAL									

ppb_v = parts per billion by volume.
$\mu g/m^3$ = micrograms per cubic meter.
ND = Not detected.
NC = Not calculated.
NA = Not available.
1. NIOSH Pocket Guide to Chemical Hazards or calculated as: [(mg/m^3)/(ppm) = MW/24.45].
2. Calculated values; see following spreadsheet.
3. Shah and Singh (1988). Environ. Sci. Technol. Vol. 22, No. 12, 1381-1388.
4. (8 hr/dy)(250 dy/yr)(25 yr)(1.14E-4 yr/hr)/25 yr
5. (8 hr/dy)(250 dy/yr)(25 yr)(1.14E-4 yr/hr)/70 yr
6. U.S. EPA (2005) IRIS (www.epa.gov/iris).
7. U.S. EPA (2005) Region 9 preliminary remediation goal tables.
8. MADEP (undated) Documentation For the Cancer Inhalation Unit Risk Value for Tetrachloroethylene.
9. MADEP (2002). Implementation of MADEP VPH/EPH Approach, Final Policy. October.
10. Value is 75th %-tile outdoor concentration.
11. Value for C9-C10 aromatic hydrocarbons (R7).
12. No value available;value for hexane applied.
13. (Avg soil gas conc)(atten. coeff.)(intake factor).
14. (Exposure Conc) / (1000)(Reference Conc).
15. (Exposure Conc)(Unit Risk)/(1000).

TABLE 5
EVALUATION OF SOIL GAS CONCENTRATIONS
McCoy Field
New Bedford, Massachusetts

Sample Identification	Indoor Air Attenuation Coefficient (α)[2] (unitless)	Non-Cancer Intake Factor [4] (unitless)	Non-Cancer Exposure Point Concentration[13] $\mu g/m^3$	Inhalation Reference Concentration (mg/m^3)	Non-Cancer Hazard Index[14] (unitless)	Cancer Intake Factor [5] (unitless)	Cancer Exposure Point Concentration[13] ($\mu g/m^3$)	Cancer Inhalation Unit Risk [$(mg/m^3)^{-1}$]	Excess Lifetime Cancer Risk[15] (unitless)	Background Indoor Air Concentration[3] ($\mu g/m^3$)
C9-C12 aliphatic hydrocarbons										
Decane										
2,4-Dimethylheptane										
2,6-Dimethylheptane										
1,2,4-Trimethylcyclohexane										
1-Methyl-4-(1-methylethyl)cyclohexane										
1,1,2,3-Tetramethylcyclohexane										
4-Methyldecane										
3-Methylnonane										
3-Ethyl-2-methylheptane										
TOTAL	6.82E-04	2.28E-01	0.0660	0.2 [7]	0.0003	--	--	--	--	90 [9]
Miscellaneous				NA	--	--	--	--	--	
2-Bromopentane	NC			NA	--	--	--	--	--	--
Cyclopentanone	NC			NA	--	--	--	--	--	--
Limonene	NC			NA	--	--	--	--	--	--
Dimethyl disulfide	7.71E-04			NA	--	--	--	--	--	--
trans-Decahydronaphthalene	NC			NA	--	--	--	--	--	--
OVERALL TOTAL		**Hazard Index =**			**0.02**	**Cancer Risk =**			**6E-07**	

ppb_v = parts per billion by volume.
$\mu g/m^3$ = micrograms per cubic meter.
ND = Not detected.
NC = Not calculated.
NA = Not available.
1. NIOSH Pocket Guide to Chemical Hazards or calculated as: $[(mg/m^3)/(ppm) = MW/24.45]$.
2. Calculated values; see following spreadsheet.
3. Shah and Singh (1988). Environ. Sci. Technol. Vol. 22, No. 12, 1381-1388.
4. (8 hr/dy)(250 dy/yr)(25 yr)(1.14E-4 yr/hr)/25 yr
5. (8 hr/dy)(250 dy/yr)(25 yr)(1.14E-4 yr/hr)/70 yr
6. U.S. EPA (2005) IRIS (www.epa.gov/iris).
7. U.S. EPA (2005) Region 9 preliminary remediation goal tables.
8. MADEP (undated) Documentation For the Cancer Inhalation Unit Risk Value for Tetrachloroethylene.
9. MADEP (2002). Implementation of MADEP VPH/EPH Approach, Final Policy. October.
10. Value is 75th %-tile outdoor concentration.
11. Value for C9-C10 aromatic hydrocarbons (R7).
12. No value available;value for hexane applied.
13. (Avg soil gas conc)(atten. coeff.)(intake factor).
14. (Exposure Conc) / (1000)(Reference Conc).
15. (Exposure Conc)(Unit Risk)/(1000).

Table 6

Calculation of Steady State Indoor Air Attenuation Coefficients

TABLE 6
CALCULATION OF STEADY STATE INDOOR AIR ATTENUATION COEFFICIENTS
McCoy Field
New Bedford, Massachusetts

Main Equation

Eq 1

$$\alpha = \frac{\left[\dfrac{D_s^{eff} A_B}{Q_{bldg} L_{SG}}\right] \cdot \mathrm{EXP}\left[\dfrac{Q_{soil} L_{crack}}{D_{crack}^{eff} A_{crack}}\right]}{\left[\exp\left(\dfrac{Q_{soil} L_{crack}}{D_{crack}^{eff} A_{crack}}\right) + \left(\dfrac{D_s^{eff} A_B}{Q_{bldg} L_{SG}}\right) + \left(\dfrac{D_S^{eff} A_B}{Q_{soil} L_{SG}}\right)\left[\exp\left(\dfrac{Q_{soil} L_{crack}}{D_{crack}^{eff} A_{crack}}\right) - 1\right]\right]}$$

or:

Eq 2

$$\text{as}\left(\frac{Q_{soil} \cdot L_{crack}}{D_{crack}^{eff} \cdot A_{crack}}\right) \to \infty, \alpha \to \left(\frac{\dfrac{D_s^{eff} \cdot A_B}{Q_{bldg} \cdot L_{SG}}}{\left(\dfrac{D_s^{eff} \cdot A_B}{Q_{soil} \cdot L_{SG}}\right) + 1}\right)$$

Equation 1 will not compute if this state is reached; Equation 2 must be u

where:

α = Steady state attenuation coefficient (unitless)
D^{eff}_s = Effective diffusivity in vadose zone soils (cm^2/s) (Calculated below)
A_B = Area of enclosed space below grade (cm^2)
Q_{bldg} = Building ventilation rate (cm^3/sec) (calculated below)
L_{SG} = Depth to soil gas source (cm)
Q_{soil} = Flow rate of soil gas into enclosed space (cm^3/s)
L_{crack} = Enclosed space foundation thickness (cm)
D^{eff}_{crack} = Effective diffusivity through soil-filled foundation cracks (cm^2/s) (Calculated below)
A_{crack} = Area of cracks (cm^2) ($= A_B \times \eta$)

Constituent	D^{eff}_s (cm^2/s)	A_B (cm^2)	Q_{bldg} (cm^3/s)	L_{SG} (cm)	Q_{soil} (cm^3/s)	L_{crack} (cm)	D^{eff}_{crack} (cm^2/s)	A_{crack} (cm^2)	α (Eq 1) (unitless)
Acetone	1.25E-02	9.24E+05	5.63E+04	91	83.3	15	1.25E-02	185	8.92E-04
Benzene	8.88E-03	9.24E+05	5.63E+04	91	83.3	15	8.88E-03	185	#NUM!
1,3-Butadiene	2.51E-02	9.24E+05	5.63E+04	91	83.3	15	2.51E-02	185	1.11E-03
2-Butanone (MEK)	8.30E-04	9.24E+05	5.63E+04	91	83.3	15	8.30E-04	185	#NUM!
Carbon Disulfide	1.05E-02	9.24E+05	5.63E+04	91	83.3	15	1.05E-02	185	8.28E-04
Chloromethane	1.27E-02	9.24E+05	5.63E+04	91	83.3	15	1.27E-02	185	8.97E-04
Cyclohexane	8.47E-03	9.24E+05	5.63E+04	91	83.3	15	8.47E-03	185	#NUM!
cis-1,2-Dichloroethene	7.43E-03	9.24E+05	5.63E+04	91	83.3	15	7.43E-03	185	#NUM!
trans-1,2-Dichloroethene	7.14E-03	9.24E+05	5.63E+04	91	83.3	15	7.14E-03	185	#NUM!
Dichlorodifluoromethane	6.71E-03	9.24E+05	5.63E+04	91	83.3	15	6.71E-03	185	#NUM!
Ethanol	1.25E-02	9.24E+05	5.63E+04	91	83.3	15	1.25E-02	185	8.90E-04
Ethylbenzene	7.57E-03	9.24E+05	5.63E+04	91	83.3	15	7.57E-03	185	#NUM!
4-Ethyltoluene	5.82E-03	9.24E+05	5.63E+04	91	83.3	15	5.82E-03	185	#NUM!
Heptane	6.65E-03	9.24E+05	5.63E+04	91	83.3	15	6.65E-03	185	#NUM!
Hexane	2.02E-02	9.24E+05	5.63E+04	91	83.3	15	2.02E-02	185	1.05E-03
Methy tert-Butyl Ether	1.03E-03	9.24E+05	5.63E+04	91	83.3	15	1.03E-03	185	#NUM!
4-Methyl-2-pentanone	7.58E-03	9.24E+05	5.63E+04	91	83.3	15	7.58E-03	185	#NUM!
Propene	3.37E-02	9.24E+05	5.63E+04	91	83.3	15	3.37E-02	185	1.19E-03
Tetrachloroethene	7.27E-03	9.24E+05	5.63E+04	91	83.3	15	7.27E-03	185	#NUM!
Toluene	8.78E-03	9.24E+05	5.63E+04	91	83.3	15	8.78E-03	185	#NUM!
Trichloroethene	7.98E-03	9.24E+05	5.63E+04	91	83.3	15	7.98E-03	185	#NUM!
1,2,4-Trimethylbenzene	6.12E-03	9.24E+05	5.63E+04	91	83.3	15	6.12E-03	185	#NUM!
Vinyl Chloride	1.07E-02	9.24E+05	5.63E+04	91	83.3	15	1.07E-02	185	8.35E-04
Xylenes (total)	8.15E-03	9.24E+05	5.63E+04	91	83.3	15	8.15E-03	185	#NUM!
C5-C8 aliphatic hydrocarbons	8.08E-03	9.24E+05	5.63E+04	91	83.3	15	8.08E-03	185	#NUM!
C9-C12 aliphatic hydrocarbons	7.07E-03	9.24E+05	5.63E+04	91	83.3	15	7.07E-03	185	#NUM!
Dimethyl disulfide	8.99E-03	9.24E+05	5.63E+04	91	83.3	15	8.99E-03	185	#NUM!

TABLE 6
CALCULATION OF STEADY STATE INDOOR AIR ATTENUATION COEFFICIENTS
McCoy Field
New Bedford, Massachusetts

$$Q_{bldg} = L_b\ W_b\ H_b\ ER$$

where:

Q_{bldg} = Building ventilation rate (cm^3/s)
L_b = Length of building (cm)
W_b = Width of building (cm)
H_b = Height of building (cm)
ER = Air exchange rate (sec^{-1})

Constituent	L_b (cm)	W_b (cm)	H_b (cm)	ER (sec^{-1})	Q_{bldg} (cm^3/s)
All	961	961	488	0.000125	5.63E+04

$$D^{eff}{}_s = D_{air} \cdot \left(\frac{\theta_{as}{}^{3.33}}{\theta_T{}^2}\right) + D_{wat} \cdot \left(\frac{1}{H}\right)\left(\frac{\theta_{ws}{}^{3.33}}{\theta_T{}^2}\right)$$

where:

$D^{eff}{}_s$ = Effective diffusivity through vadose zone soil and soil-fillied foundation cracks ($D^{eff}{}_{crack}$) (cm^2/s)
D_{air} = Diffusion coefficient in air (cm^2/s)
D_{wat} = Diffusion coefficient in water (cm^2/s)
H = Henry's Law Constant (cm^3/cm^3)
θ_{as} = Air content in vadose zone soil (cm^3/cm^3)
θ_{ws} = Water content in vadose zone soil (cm^3/cm^3)
θ_T = Total soil porosity (cm^3/cm^3)

From subsurface (H at 10 ^oC)

Constituent	D_{air} (cm^2/s)	D_{wat} (cm^2/s)	θ_{as} (cm^3/cm^3)	θ_{ws} (cm^3/cm^3)	θ_T (cm^3/cm^3)	H (cm^3/cm^3)	$D^{eff}{}_s/D^{eff}{}_{crack}$ (cm^2/s)
Acetone	1.24E-01	1.14E-05	0.28	0.10	0.387	1.59E-03	1.25E-02
Benzene	8.80E-02	9.80E-06	0.28	0.10	0.387	2.27E-01	8.88E-03
1,3-Butadiene	2.49E-01	1.08E-05	0.28	0.10	0.387	3.01E+00	2.51E-02
2-Butanone (MEK)	8.08E-03	9.80E-06	0.28	0.10	0.387	2.29E-03	8.30E-04
Carbon Disulfide	1.04E-01	1.00E-05	0.28	0.10	0.387	1.24E+00	1.05E-02
Chloromethane	1.26E-01	6.50E-06	0.28	0.10	0.387	3.61E-01	1.27E-02
Cyclohexane	8.39E-02	9.10E-06	0.28	0.10	0.387	7.84E+00	8.47E-03
cis-1,2-Dichloroethene	7.36E-02	1.13E-05	0.28	0.10	0.387	1.67E-01	7.43E-03
trans-1,2-Dichloroethene	7.07E-02	1.19E-05	0.28	0.10	0.387	3.84E-01	7.14E-03
Dichlorodifluoromethane	6.65E-02	9.92E-06	0.28	0.10	0.387	1.40E+01	6.71E-03
Ethanol	1.23E-01	1.24E-05	0.28	0.10	0.387	1.20E-03	1.25E-02
Ethylbenzene	7.50E-02	7.80E-06	0.28	0.10	0.387	3.22E-01	7.57E-03
4-Ethyltoluene	5.76E-02	7.80E-06	0.28	0.10	0.387	2.02E-01	5.82E-03
Heptane	6.59E-02	7.59E-06	0.28	0.10	0.387	8.41E+01	6.65E-03
Hexane	2.00E-01	7.77E-06	0.28	0.10	0.387	6.82E+01	2.02E-02
Methy tert-Butyl Ether	1.02E-02	1.05E-05	0.28	0.10	0.387	2.56E-02	1.03E-03
4-Methyl-2-pentanone	7.50E-02	7.80E-06	0.28	0.10	0.387	5.64E-03	7.58E-03
Propene	3.34E-01	1.19E-05	0.28	0.10	0.387	1.65E+01	3.37E-02
Tetrachloroethene	7.20E-02	8.20E-06	0.28	0.10	0.387	7.53E-01	7.27E-03
Toluene	8.70E-02	8.60E-06	0.28	0.10	0.387	2.72E-01	8.78E-03
Trichloroethene	7.90E-02	9.10E-06	0.28	0.10	0.387	4.20E-01	7.98E-03
1,2,4-Trimethylbenzene	6.06E-02	7.92E-06	0.28	0.10	0.387	2.52E-01	6.12E-03
Vinyl Chloride	1.06E-01	1.23E-05	0.28	0.10	0.387	1.10E+00	1.07E-02
Xylenes (total)	8.07E-02	1.00E-05	0.28	0.10	0.387	2.12E-01	8.15E-03
C5-C8 aliphatic hydrocarbons	8.00E-02	1.00E-05	0.28	0.10	0.387	5.40E+01	8.08E-03
C9-C12 aliphatic hydrocarbons	7.00E-02	1.00E-05	0.28	0.10	0.387	6.50E+01	7.07E-03
Dimethyl disulfide	8.34E-02	1.01E-05	0.28	0.10	0.387	6.14E-05	8.99E-03

TABLE 6
CALCULATION OF STEADY STATE INDOOR AIR ATTENUATION COEFFICIENTS
McCoy Field
New Bedford, Massachusetts

Input Variables

Variable	Notation	Value	Units	Reference
Total soil porosity	θ_T	0.387	cm^3/cm^3	Representative of sandy loam (U.S. EPA 2003)
Bulk soil density	ρ_s	1.62	g/cm^3	Representative of sandy loam (U.S. EPA 2003)
Water content in vadose zone soils	θ_{ws}	0.103	cm^3/cm^3	Representative of sandy loam (U.S. EPA 2003)
Air content in vadose zone soils	θ_{as}	0.284	cm^3/cm^3	θ_T -$\theta_{WS.}$
Building air exchange rate	ER	0.000125	s^{-1}	MADEP (2004).
Enclosed space height	$L_{B,}$ H_b	488	cm	MADEP (2004).
Foundation thickness	L_{crack}	15	cm	MADEP (2004).
Areal fraction of cracks in foundatio	η	0.0002	cm^2/cm^2	U.S. EPA (2003).
Building length	L_b	961	cm	MADEP (2004).
Building width	W_b	961	cm	MADEP (2004).
Area of building	A_B	9.24E+05	cm^2	Equals L_b x $W_{b.}$
Flow rate of soil gas	Q_{soil}	83.3	cm^3/s	U.S. EPA (2003).
Depth of soil gas measurement	L_{SG}	91	cm	3 feet (below cover)

U.S. EPA (2003). Users Guide for Evaluating Subsurface Vapor Intrusion Into Buildings. June.
MADEP (2004). Proposed Revised Method 1 Numerical Standards and supporting documentation (September).

Constituent	Henry's Law Constant H (cm^3/cm^3)		Diffusion Coefficient in Air D_{air} (cm^2/s)		Diffusion Coefficient in Water D_{wat} (cm^2/s)	
Acetone	1.59E-03	[1]	1.24E-01	[1]	1.14E-05	[1]
Benzene	2.27E-01	[1]	8.80E-02	[1]	9.80E-06	[1]
1,3-Butadiene	3.01E+00	[1]	2.49E-01	[1]	1.08E-05	[1]
2-Butanone (MEK)	2.29E-03	[1]	8.08E-03	[1]	9.80E-06	[1]
Carbon Disulfide	1.24E+00	[1]	1.04E-01	[1]	1.00E-05	[1]
Chloromethane	3.61E-01	[1]	1.26E-01	[1]	6.50E-06	[1]
Cyclohexane	7.84E+00	[2]	8.39E-02	[2]	9.10E-06	[2]
cis-1,2-Dichloroethene	1.67E-01	[1]	7.36E-02	[1]	1.13E-05	[1]
trans-1,2-Dichloroethene	3.84E-01	[1]	7.07E-02	[1]	1.19E-05	[1]
Dichlorodifluoromethane (Freon 12	1.40E+01	[1]	6.65E-02	[1]	9.92E-06	[1]
Ethanol	1.20E-03	[3]	1.23E-01	[3]	1.24E-05	[3]
Ethylbenzene	3.22E-01	[1]	7.50E-02	[1]	7.80E-06	[1]
4-Ethyltoluene	2.02E-01	[2]	5.76E-02	[2]	7.80E-06	[3]
Heptane	8.41E+01	[2]	6.59E-02	[2]	7.59E-06	[2]
Hexane	6.82E+01	[1]	2.00E-01	[1]	7.77E-06	[1]
Methy tert-Butyl Ether	2.56E-02	[1]	1.02E-02	[1]	1.05E-05	[1]
4-Methyl-2-pentanone (MIBK)	5.64E-03	[1]	7.50E-02	[1]	7.80E-06	[1]
Propene	1.65E+01	[3]	3.34E-01	[3]	1.19E-05	[3]
Tetrachloroethene	7.53E-01	[1]	7.20E-02	[2]	8.20E-06	[1]
Toluene	2.72E-01	[1]	8.70E-02	[1]	8.60E-06	[1]
Trichloroethene	4.20E-01	[1]	7.90E-02	[1]	9.10E-06	[1]
1,2,4-Trimethylbenzene	2.52E-01	[1]	6.06E-02	[1]	7.92E-06	[1]
Vinyl Chloride	1.10E+00	[1]	1.06E-01	[1]	1.23E-05	[1]
Xylenes (total)	2.12E-01	[1]	8.07E-02	[2]	1.00E-05	[1]
C5-C8 aliphatic hydrocarbons	5.40E+01	[4]	8.00E-02	[4]	1.00E-05	[4]
C9-C12 aliphatic hydrocarbons	6.50E+01	[4]	7.00E-02	[4]	1.00E-05	[4]
Dimethyl disulfide	6.14E-05	[3]	8.34E-02	[3]	1.01E-05	[3]

1. U.S. EPA (2003). Users Guide for Evaluating Subsurface Vapor Intrusion into Buildings. June
2. TPHCWG (1998). Composition of Petroleum Mixtures. Amherst Scientific Publishing. November.
3. U.S. EPA (1994). ChemDat8 Users Guide. EPA453/C-94-080B, November.
4. MADEP (2002). Implementation of MADEP VPH/EPH Approach, Final Policy. October.

TABLE 6
CALCULATION OF STEADY STATE INDOOR AIR ATTENUATION COEFFICIENTS
McCoy Field
New Bedford, Massachusetts

used.

α (Eq 2) (unitless)
8.92E-04
7.67E-04
1.11E-03
1.35E-04
8.28E-04
8.97E-04
7.49E-04
7.01E-04
6.86E-04
6.64E-04
8.90E-04
7.08E-04
6.11E-04
6.60E-04
1.05E-03
1.64E-04
7.08E-04
1.19E-03
6.93E-04
7.63E-04
7.27E-04
6.30E-04
8.35E-04
7.35E-04
7.32E-04
6.82E-04
7.71E-04